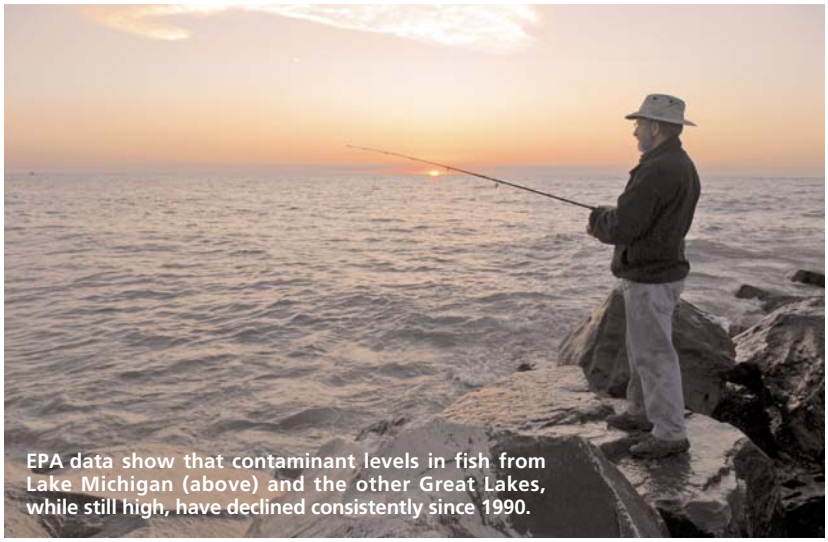
Angling for Thyroid Answers

Study Links PBDEs to Hormone Disruption in Male Sport-Fish Consumers

Levels of polybrominated diphenyl ethers (PBDEs) measured in human samples have increased in recent years, but the health effects of these compounds are not well studied. A group of persistent pollutants similar in structure to polychlorinated biphenyls (PCBs), PBDEs are thought to affect endocrine function, but this relationship has only been examined in several small studies. A new study significantly expands this knowledge base by analyzing PBDE exposure among a large cohort of male sport-fish consumers and concluding that these exposures are associated with increased thyroglobulin antibodies and increased thyroxine (T_4) in adult males independent of PCB exposure [***EHP* 116:1635–1641; Turyk et al.**].



EPA data show that contaminant levels in fish from Lake Michigan (above) and the other Great Lakes, while still high, have declined consistently since 1990.

The study examined 405 adult males who consumed sport fish from the Great Lakes during the early 1990s. Researchers gathered data on the subjects' levels of fish consumption, medical diseases, and use of medications, and took serum samples that were tested for PBDEs, PCBs, and DDE, a metabolite of DDT that may affect thyroid hormones. Total and free T_4 and triiodothyronine (T_3) were measured in serum and urine.

PBDE concentrations were positively associated with increased T_4 and reverse T_3, and inversely correlated with total T_3 and thyroid-stimulating hormone (TSH). In addition, PBDEs were positively related to the percentage of T_4 bound to albumin, a carrier protein. An observed increase in thyroglobulin antibodies in men with the highest PBDE exposures may indicate an increased susceptibility to autoimmune thyroiditis among people who have been exposed to PBDEs, according to the authors.

The findings of a positive association of PBDEs with T_4 are not consistent with results of animal studies that have shown decreased T_4 in rats and mice exposed to PBDE. However, the results do align with those of several smaller human studies. The authors speculate the disparity may be attributable to the fact that, while thyroid hormone regulation is similar among vertebrates, some functions differ by species.

A major strength of the study is the measurement of the effects of PBDEs on multiple hormones and the consideration of other environmental exposures that can affect thyroid hormones. The authors point out that their findings provide a rationale for future mechanistic studies related to PBDE exposure, including how those exposures may be linked to changes in thyroid hormone metabolism and binding of T_4 to serum-binding proteins. Also needed, they write, are larger studies to determine whether PBDE exposure is related to thyroid disease in human populations. –Richard Dahl

A Measure for Mothers

Model Predicts Lactational Transfer of PCB-153

Breastfed infants sit at the top of the food chain for the simple reason that their nourishment comes from other humans. Through biomagnification, environmental chemicals such as polychlorinated biphenyls (PCBs) are passed up the food chain to the nursling. Although epidemiologic studies have established an association between prenatal PCB exposures and neurodevelopmental and neurobehavioral problems, the potential health risks of xenobiotic exposures via human milk are less clear and remain an area of intense research interest [see "Contaminants in Human Milk: Weighing the Risks against the Benefits of Breastfeeding," *EHP* 116:A426–A434 (2008)]. Researchers have now developed a physiologically based pharmacokinetic model of PCB-153 in women to predict the transfer of this compound via lactation [***EHP* 116:1629–1634; Redding et al.**].

PCB-153 was selected for study because it is the most prevalent PCB congener in human tissues. To predict the concentration of PCB-153 in human milk, physiological parameters were obtained from a Taiwanese cohort and from reference values in published studies. Partition coefficients were estimated based on chemical structure and the lipid content in various body tissues as reported in the literature: liver, fat, mammary tissue, and the "rest of the body" (an average of brain, skin, and muscle), as well as a mixed blood compartment.

The investigators predicted the acquired body burden of PCB-153 from birth over a 25-year period on the basis of estimates of exposure via diet using data from Japanese population studies. They then compared the model's predictions with measurements from published studies in multiple countries.

Blood and tissue concentrations for a 25-year-old woman generated by the model were found to fall within ranges reported in the literature, assuming that dietary intake of PCB-153 was the principal source of this chemical in human milk. Additionally, the researchers demonstrated the use of the model for reverse dosimetry, also referred to as "exposure reconstruction," for possible exposure scenarios in Canadian Inuits, who consume extremely high levels of PCB-153 through their traditional high-fat diet.

This human, population-scale lactational model for PCB-153 is the first to successfully predict a range of results that encompass human biomonitoring data of milk PCB-153 content from all over the world. The primary value of this model will be its ability to describe the distribution, absorption, metabolism, and elimination of PCB-153 in nursing women. The new tool could also be useful for reverse dosimetry modeling to enable retrospective analyses of potential health effects of PCB exposures in breastfed individuals. –M. Nathaniel Mead

Bisphenol A Suppresses Release of Adipose Hormone

Exposure May Contribute to Metabolic Syndrome

Bisphenol A (BPA), a chemical used in the manufacture of numerous consumer products, is ubiquitous throughout the environment, and its widespread presence in human serum has been well documented. Although animal research indicates that BPA can alter several metabolic functions, interpretation of human data has been more controversial. A new study now presents evidence confirming that exposure of human adipose tissue and isolated fat cells to environmentally relevant levels of BPA suppresses release of the hormone adiponectin [***EHP* 116:1642–1647; Hugo et al.**].

A high-calorie diet and sedentary lifestyle have both traditionally been linked to metabolic syndrome—the presence of a constellation of metabolic risk factors including insulin resistance, hypertension, and elevated blood sugar and lipid levels—but researchers are now examining environmental factors as additional causes. Adiponectin increases insulin sensitivity and reduces tissue inflammation, so suppression of its release could lead to insulin resistance and increased susceptibility to metabolic syndrome, the authors write.

The study examined three types of adipose tissue samples taken during breast reduction, abdominoplasty, and gastric bypass surgery. The research team incubated each type of tissue for 6 hours in BPA or estradiol (E_2), an endogenous human estrogen. They used enzyme-linked immunosorbent assay to measure secreted adiponectin. They also used quantitative real-time polymerase chain reaction to compare the expression of estrogen receptors and estrogen-related receptors in these tissues.

In all three tissue types, exposure to low-nanomolar concentrations of BPA suppressed adiponectin as effectively or more effectively compared with equimolar concentrations of E_2. The authors also showed that the dose response to BPA was nonmonotonic, meaning lower doses caused different effects than higher doses. Finally, they report for the first time similar mRNA expression levels for several estrogen receptors in visceral adipose tissue, although the role of these receptors in the suppressive nature of BPA and E_2 has yet to be determined.

The results of the data are limited by the relatively small sample size in each tissue category, as well as the potential unknown effects of age or obesity on tissue responsiveness. However, the authors write that their data present clear evidence that BPA suppresses adiponectin, potentially leading to a much higher risk of developing metabolic syndrome and its resultant adverse health effects. They conclude that with BPA's persistence in the environment, more research should be done to determine the mechanism by which the chemical suppresses adiponectin. –Tanya Tillett

New Pesticides, Old Problems

Despite Warnings, Use during Pregnancy Persists

The sight of scurrying cockroaches trumps warnings against using pesticides during pregnancy. That's one insight from a study of pesticide use before and after the U.S. Environmental Protection Agency's 2001 and 2002 retail sales restrictions of chlorpyrifos and diazinon [***EHP* 116:1681–1688; Williams et al.**]. The team of U.S. researchers also found that use of replacement pesticides is steadily increasing to fill the void, that the air the test subjects breathed remains surprisingly contaminated with chlorpyrifos and diazinon up to 5 years after the restrictions went into effect, and that household use of pesticide spray cans and bug bombs contaminated the air far more than did use of bait traps or boric acid or spraying by professional exterminators.

In the study, 511 pregnant inner-city women wore personal air samplers for a 48-hour period during their third trimester and reported pesticide use and sightings of pests throughout pregnancy. The researchers compared their findings from subjects enrolled in the study between 2000 and 2001 with those from subjects enrolled between 2002 and 2006. This reflected the timing of the pesticide bans—retail sales of chlorpyrifos were phased out at the end of 2001 and diazinon at the end of 2002. Participants received regular newsletters containing pertinent information, including warnings about potential health effects of residential pesticide use and information on alternative pest control methods.

Tim Starkey/iStockphoto

This and other studies have reported a strong association between the degree of housing disrepair and both pest sightings and use of pest control measures.

For 6 months after chlorpyrifos went off the market, use of replacement pesticides fell, perhaps due to elevated awareness of pesticide dangers. But a steady, significant increase in sightings of cockroaches, the most commonly observed pest, was correlated with a steady, significant increase in the use of replacement pesticides for every 6-month period from 2002 through 2006. Throughout the study period, at least 85% of the women reported using pesticides.

Chlorpyrifos and diazinon were found in more than 98% of air samples both before and after the phase-outs, and 18–75% of the personal air samples contained at least 1 replacement pesticide. The chemicals the researchers measured included permethrin (a commonly used pyrethroid) and piperonyl butoxide (a pyrethroid synergist, or chemical added to a pesticide to increase its effectiveness). The authors say this is the first study to document extensive residential exposure to piperonyl butoxide.

Data on health effects of these pyrethroid products at the measured concentrations are limited. However, there is growing evidence of health and environmental damage from these products, which are proving to be ubiquitous both indoors and out. The authors say their findings indicate that these products warrant additional research on their use, occurrence, and health effects. They also noted that pest resistance to pyrethroids may be playing a role in pest increases. –Bob Weinhold